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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/058,946	01/30/2002	Akira Goda	218447US2TTC	4857
22850	7590	07/13/2005	EXAMINER	
OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314			IM, JUNGHWA M	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 07/13/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/058,946

Applicant(s)

GODA ET AL.

Examiner

Junghwa M. Im

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 25 April 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 54-57 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 54-56 is/are rejected.
- 7) ☒ Claim(s) 57 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on April 25, 2005 has been entered.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 54 and 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sukagami (US 2002/0033501), in view of Yu et al. (US 6,376,877), hereinafter Yu.

Regarding claim 54, Fig. 11 of Sukagami shows a semiconductor device comprising:

a semiconductor substrate (101);

a memory cell (one of the cells to the left in Fig. 11) having a first channel and a first gate insulating film formed on the semiconductor substrate, the first gate insulating film (111, 112, 150) comprising multiple layer films including a charge storage layer (112);

Art Unit: 2811

first shallow trench isolation regions (126) formed in trenches provided in the semiconductor substrate, the memory cell being sandwiched between the first shallow trench isolation regions;

a transistor (one of the cells in the center in Fig. 11) having a second channel and a second gate insulating film formed on the semiconductor substrate; and

second shallow trench isolation regions formed in trenches provided in the semiconductor substrate, the transistor being sandwiched between the second shallow trench isolation regions;

wherein the first shallow trench isolation regions have first portions on upper ends thereof;

wherein the second shallow trench isolation regions have second portions on upper ends thereof, wherein an entire extent of the first ends portions are formed above the charge storage layer,

wherein a film thickness of the first gate insulating film at a central portion of the first channel and at portions contacting with the first shallow trench isolation regions are equal, and

wherein a film thickness of the second gate insulating film at a central portion of the second channel and at portions contacting with the second shallow trench isolation regions are equal.

Fig. 11 of Sukagami shows most aspect of the instant invention except that the first shallow trench isolation regions and the second shallow trench isolation regions have concave portions on upper ends. Fig. 6C of Yu shows the shallow trench isolation regions (316c, 317C, 318C) include concave portions on upper ends. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Yu into the

Art Unit: 2811

device of Sukagami in order to have the shallow trench isolation regions including concave portions on upper ends to improve the yield.

Regarding claim 56, Fig. 11 of Sukagami shows the gate insulating film includes a first insulating film as the charge storage layer (112) comprised of silicon and nitrogen as main constituent elements thereof (paragraph [0054]) and a second insulating film (150) formed on the first insulating film, the second insulating film comprised of silicon and oxygen (paragraph [0056]), and a third insulating film (111) formed between the first insulating film and the semiconductor substrate, the third insulating film comprised of silicon and oxygen (paragraph [0056]), and wherein a film thickness of the second insulating film at a central portion of the first channel and at portions contacting with the first shallow trench isolation regions are equal.

Claim 55 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sakagami and Yu as applied to claim 54 above, and further in view of Hurley et al. (US 6,624,022), hereinafter Hurley.

Regarding claim 55, the combined teachings of Sakagami and Yu show the most aspect of the instant invention except "heights, from a surface of the semiconductor substrate, of upper surfaces of the first trench isolation regions are higher than heights, from the surface of the semiconductor substrate, of upper surfaces of the second trench isolation regions." Fig. 3 of Hurley shows heights, from a surface of the semiconductor substrate (12), of upper surfaces of the first trench isolation regions are higher than heights, from the surface of the semiconductor substrate, of upper surfaces of the second trench isolation regions.

It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Hurley into the device of Sakagami and Yu in order to have “heights, from a surface of the semiconductor substrate, of upper surfaces of the first trench isolation regions are higher than heights, from the surface of the semiconductor substrate, of upper surfaces of the second trench isolation regions” to improve charge retention.

### *Allowable Subject Matter*

Claim 57 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is an examiner's statement of reasons for allowance. Prior art fails to teach or render obvious a semiconductor device with combinations of elements as set forth in the claims, including in particular, the conductivity types of the electrodes of the memory cell and transistor are opposite to each other.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

### *Response to Arguments*

Applicant's arguments with respect to pending claims have been considered but are moot in view of the new ground(s) of rejection.

Art Unit: 2811

*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junghwa M. Im whose telephone number is (571) 272-1655. The examiner can normally be reached on MON.-FRI. 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's acting supervisor, Stephen Loke can be reached on (571) 272-1657. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

jmi

Steven Loke  
Primary Examiner

